Analyzing NBA Player Performance Through Network Analysis

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Introduction and Goal of Study

The goal of this study was to produce a ranking of players on each NBA team based on their holistic contribution to the team's success. Players can affect the game in so many immeasurable ways, and while there have been improvements to the traditional box score metrics with advent of adjusted plus/minus and other advanced stats, some players' impacts may still be overlooked. This study attacks the issue of properly valuing a player's impact through network analysis. By ignoring individual statistics and focusing on the performance of the 5-man lineups of which the player participated in, the intangible effects the player may have on a lineup's performance are accounted for. With a more complete understanding of each players' impact on a lineup's performance, coaches can better tailor allocation of playing time and general managers can better target areas of the roster to improve upon.

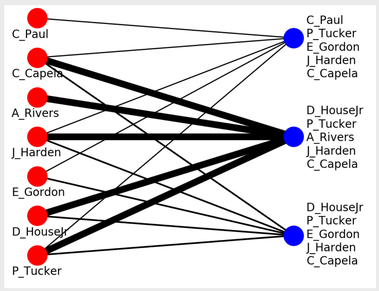
NBA API

The NBA records massive amount of data from each game. The league makes the data available for analyses like this via URL endpoints to its website. The availability of reliable, filterable data is key to a study like this. This study relied upon the nba_api (https://github.com/swar/nba_api) to pull data detailing the performance of each lineup that each NBA team played during the 2018-19 season from the stats.nba.com endpoint (https://stats.nba.com/stats/teamdashlineups).

Building Team Networks

Player-Lineup Bipartite Graph

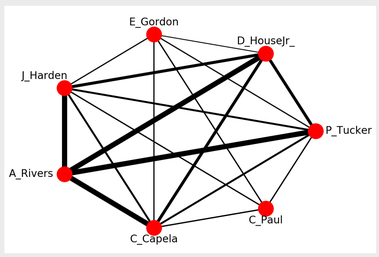
Bipartite graphs with one set of nodes as players and the other as 5-man lineups is created for each NBA team. A player is connected to each of the 5-man lineups that he was apart of. Each lineup node holds attributes for the number of minutes that lineup played throughout the 2018-19 season and a metric value describing the lineup's performance.



Projection to Player Only Network

The bipartite network is projected into a unimodal player-only graph. The weight of the edge between players represents the weighted average performance of all the lineups that the two players played in together.
The following formula describes how edge weights are calculated:

$$EdgeWeight_i = \frac{\sum(MinutesPlayed_i * MetricValue_i)}{\sum MinutesPlayed_i} \quad (1)$$



Results

Player Rankings

By finding the eigenvector centralities of the weighted player-only network, the player nodes can be ranked on how influential they were to the lineups that they were apart of. Player rankings were created for each NBA team with various metrics defining "success" of the lineup. Below, see the rankings (1-8) for the Boston Celtics for Offensive Rating and the Golden State Warriors for True Shooting Percentage.

Celtics - Offensive Rating

1. Kyrie Irving
2. Jayson Tatum
3. Marcus Smart
4. Marcus Morris
5. Gordon Hayward
6. Jaylen Brown
7. Terry Rozier
8. Al Horford

Warriors - True Shooting %

1. Klay Thompson
2. Stephen Curry
3. Andre Iguodala
4. Kevin Durant
5. Draymond Green
6. Jonas Jerebko
7. Kevon Looney
8. Sean Livingston

Teammate Rankings

From the weighted player only network, individual player nodes can be focused on to see which teammates they excel with. By looking at edge weights from an individual player node, a ranking system can be created of which teammates the player plays best with. Below, teammate rankings (1-7) for Devin Booker are shown for both Offensive Rating and Effective Net Rating.

Offensive Rating

1. Kelly Oubre Jr
2. Elie Okobo
3. Tyler Johnson
4. Mikal Bridges
5. Jamal Crawford
6. DeAndre Ayton
7. De'Anthony Melton

Effective Net Rating

1. Jamal Crawford
2. Kelly Oubre Jr
3. Tyler Johnson
4. Ryan Anderson
5. Dragan Bender
6. Mikal Bridges
7. DeAndre Ayton

Discussion and Analysis

The two main use cases are described under the Results column. In theory, head coaches could look into rankings for specific metrics they are interested in focusing on and general managers could use teammate rankings to better understand how to build their roster to optimize their top talents.

- **Player Ranking Example -** Against a specific team, a coach wants his team to play at a faster pace (i.e. more fastbreak possessions and less half court offensive sets). He could look at the rankings built on the pace metric to see which players should play more that game.
- **Teammate Ranking Example -** A team has a young, star player under contract for 5 more years and want to build a roster that will allow him to play his best. In the Devin Booker example in the Results column, wing players and combo guards are atop the rankings for both metrics shown. With these types of players at the top, it might be worth looking to invest in talented backcourt players to surround Booker with for the remainder of his contract.

Further Work

- With many metrics available, a set of rankings can be created for each metric. An obvious extension would be to explore different metrics.
- This study only looks at lineups that played a minimum 27 minutes. This number was picked as it included lineups that averaged at least 1 minute together every 3 games. Varying this bound could produce interesting results as well.
- Another extension would be to look at how rankings change from year to year. By building networks based on previous year's data, the progression of a player's impact and growth can be studied.

Conclusion

By studying the NBA teams through network analysis, a player's complete impact can be comparatively evaluated to his teammates. If lineups tend to perform better when player A is on the court compared to when a different player B is out there, it is logical to say that player A has a larger positive impact. By varying the statistical metric that measures the "success" of a lineup, there is a broad range of player rankings that can be created.

References and Acknowledgments

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